



Expertise and Effective Office Warning Strategies

Advanced Warning Operations Course
IC Core 3

Lesson 2: Cognitive Task Analysis

Warning Decision Training Branch



Continuing through the Expertise and Effective Office Warning Strategies instructional component, we will now look at a Cognitive Task Analysis (CTA) of the warning process.

Lesson 2:

Cognitive Task Analysis of Expert Warning Forecasters

**What does expertise
look like in NWS
warning operations?**

COGNITIVE TASK ANALYSIS OF THE WARNING FORECASTER TASK

Final Report

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This lesson will share result of a CTA which was recently conducted using NWS expert warning forecasters.

Overview

1. What is a cognitive task analysis (CTA)
 - Process
2. CTA of NWS warning forecaster task: Findings
 - For experts, weather is not a job, but a way of life
 - The warning environment is technologically rich
 - Experts use a grounded warning process
 - Experts put a high value on base data analysis
 - Experts weigh all inputs
 - Experts continually develop and refine mental models
 - Experts study numerous past events
 - Experts know the importance of working in teams
 - Experts are focused on serving the public
 - The experts' biggest challenges

We'll discuss what we mean by the term Cognitive Task Analysis, or CTA, and the process by which it was conducted. We will also look at the findings from this study. These findings help us get a good picture of what an expert does and thinks as he or she encounters a severe weather event.

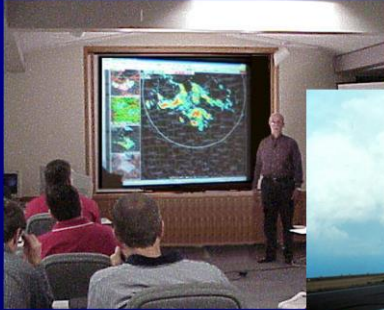
Learning Objectives

1. Define a cognitive task analysis (CTA)
2. Identify results of the cognitive task analysis on the National Weather Service warning forecaster task

The learning objectives, which are testable, involve defining a CTA, and identifying the results of this particular CTA.

Cognitive Task Analysis (CTA)

Definition: Cognitive Task Analysis is a study of the mental processes needed to perform a task proficiently



Can assist in the design of research and training to develop expertise



Can assist in the direction and design of hardware and software to foster use of expertise

Did you ever work with someone who was about to retire and think, “Man we need to clone him before he leaves!” Well a CTA tries to see what the characteristics of that “clone” might involve, at least in the area of interest. In this context, a CTA is defined as a study of the mental processes needed to perform a task proficiently. While a “task analysis” looks at the job tasks which are done to accomplish a goal, the CTA focuses on the thinking processes and reasoning of the person doing the task. Not just what they do, but how they come to the decisions they come to. A CTA can be done on anyone, but if you are attempting to capture and grow expertise, it is important to do this with those who are considered experts. Findings from a CTA can help design research needs and guide training efforts in the direction of fostering, in our case, warning expertise. The results can also be used to direct hardware and software design to assist the expert in using their expertise, instead of working against them.

CTA Process

- Klein Associates performed CTA on expert NWS warning forecasters
 - Six recognized experts interviewed
 - Between 12 and 20 years experience
 - Work experience covered most US climatological regimes
- Goal was to capture expertise via the Critical Design Method
 - CDM uses layers of interviews to capture past events
 - Documents actual past actions versus hypothetical future actions
- One novice interviewed

For the NWS CTA, Klein Associates, an organization which does human factors research with other high-stress, pressured domains (Army command and control, Aircraft carrier flight control) was commissioned to conduct a CTA on NWS warning forecasters. They interviewed 6 recognized warning forecast experts, each of which had between 12 and 20 years of experience in offices which covered all aspects of weather across the U.S. In addition, one novice was interviewed, the results of which were used as a control. The process involved interviews of actual events worked by each of the experts, rather than hypothetical situations. In other words, the CTA was focused around what these experts did, not what they might do. Many of you looking at this are probably considered experts, or know someone who is. The findings here will likely NOT be any surprise to you and in fact may describe you!

Finding: Weather is Not a Job, but a Way of Life



Dynamic – not a job
but a way of life



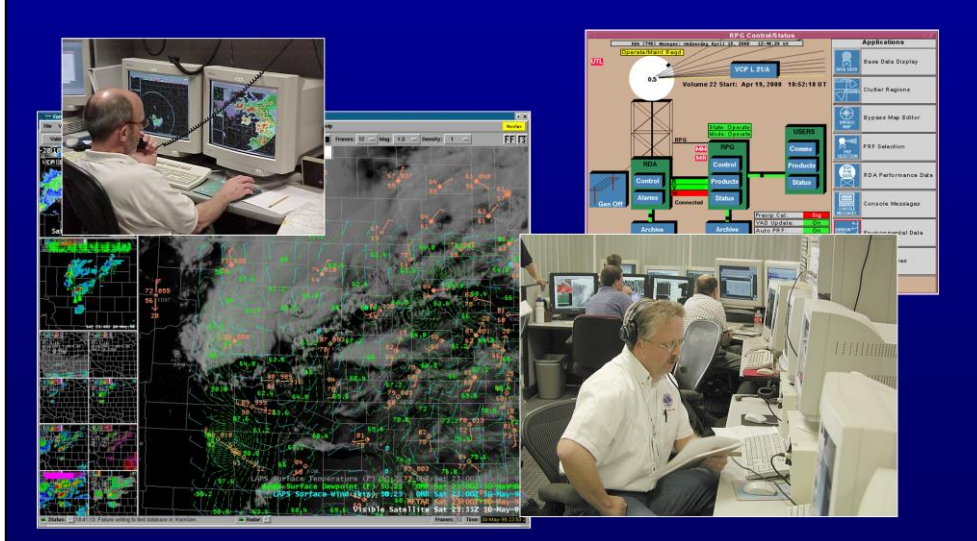
Allows for constant
learning – not just on the
job



The CTA produced several findings. First was the way that the experts approached weather in general. None considered weather an “8 to 5” job. They were on a lower level of “watch” when off duty but on watch nonetheless. What this means is that they are constantly in a learning, observing mode. The field of weather affords that opportunity more so than other domains. Experts will take advantage of this. By the time they go on duty, they’ve already formulated some expectations about what is in store for them that day. However, experts will frequently reassess expectations which helps prevent them from locking in on their initial assessment.

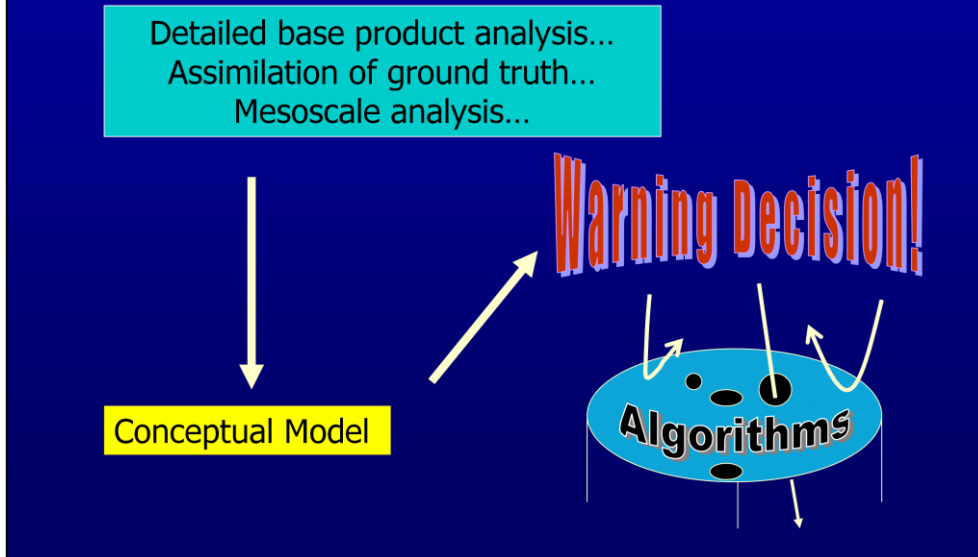
Finding:

The Warning Environment is Technologically Rich



The second finding involved the use of technology. As you all know, the warning environment is technologically rich, and getting richer every day! This requires experts to have a strong understanding of the domain in which they are immersed and a constant effort to properly use the technology to the best outcome.

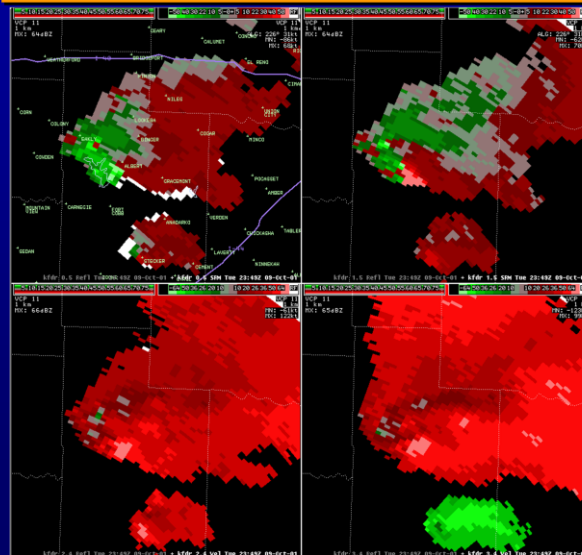
Finding: Experts Use a Grounded Warning Process



One of the ways experts do this is with a grounded warning process. This process is built around detailed and frequent base data analysis, the assimilation of ground truth, and considerations for the impacts of a representative mesoscale analysis. These things help illuminate conceptual models which help bring order and expectation out of the mountains of available data. The warning decision comes from this process, with the use of algorithms as a safety net to help catch things that slip through the cracks. The experts were aware however that this safety net has “holes” and therefore to rely on algorithms as a “first line of defense” is dangerous.

Finding:

Experts Put a High Value on Base Data Analysis



Advantage

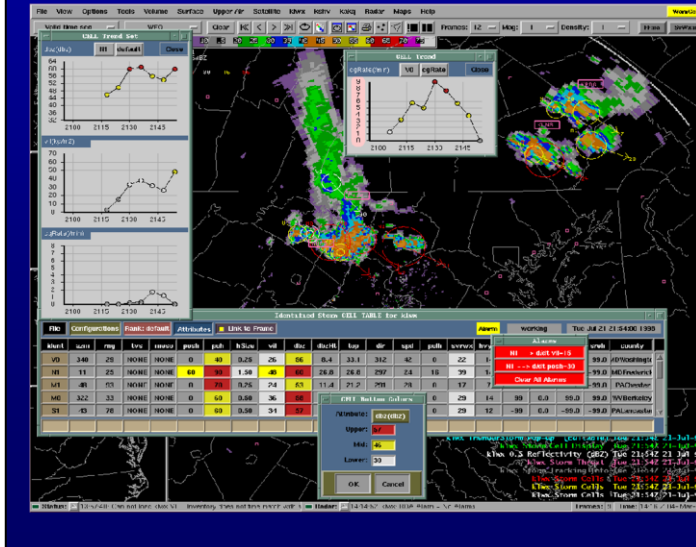
- Closest to the “truth”
- Available sooner
- Conceptual models are recognized in base data
- Algorithms require verification in base data anyway

Disadvantage

- Can be labor intensive
- Requires interpretation skills

All the experts interviewed here put a high value on base data analysis. They have developed numerous procedures and methodologies to make this analysis as quick and easy as possible. Their reasoning primarily comes from the base data being the closest data one has to the “truth”, with each step of processing thereafter having the potential of introducing additional levels of uncertainty. Since these experts are very aware of conceptual models, they are able to use the base data to recognize and validate those models. The challenges of base data analysis for these experts is the workload it places on individuals. However, most placed a high priority of ensuring staffing to support this effort.

Finding: Experts Use Decision Aides



- Used as a “safety net”
- Reliability and applicability are important
- Value related to forecaster’s ability to trace output back to its base data input (confidence)

Decision aides, which may or may not use the output of algorithms, were also used to support expert warning forecasters. The experts found value in those outputs which were easily traceable to their base data inputs. This ability allowed them to develop confidence and reduce uncertainty. Outputs which added value above and beyond what was readily detectable in the base data were used more often. However, outputs which were difficult to verify or validate were considerably less likely to be used. On the other hand, novices are more likely to use decision aids without questioning their validity.

Finding: Experts Weight All Inputs

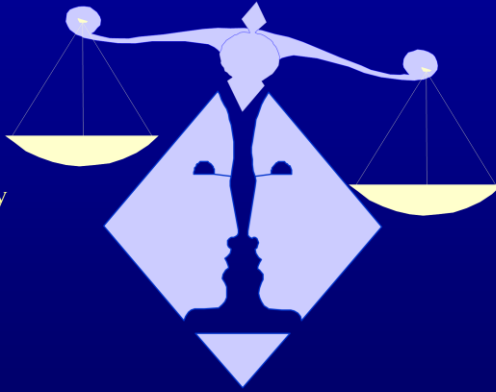
For

Multiple TDA
detections

High shear in SRM

Supercell reflectivity
structure

Reports of damage



Against

SRM shear lacks
height continuity

High SW

Gust front well
south of TDA

Not climatologically
favored

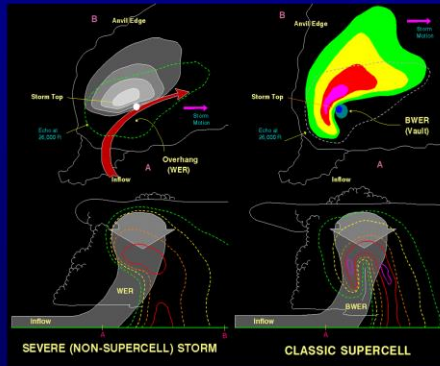
Damage could be
from high wind

For the expert warning forecasters, all data gets weighed against all other data, and in the context in which it is received. All data sources rarely point to an “obvious” answer. In addition, no one piece of data (except on extremely rare occasions) is ever enough to base a decision upon. The expertise comes in deciding on which side of the scale inputs reside and how much weight each carries with it. The context in which the event is occurring is always being considered.

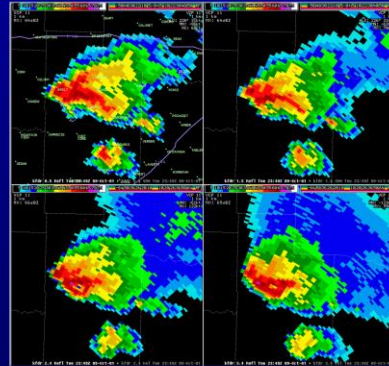
Finding:

Experts Continually Develop and Refine Mental Models

- Important to develop a range of possibilities
- Resolve differences in datasets
- Select data sets/maximize screen real-estate to fit expectations



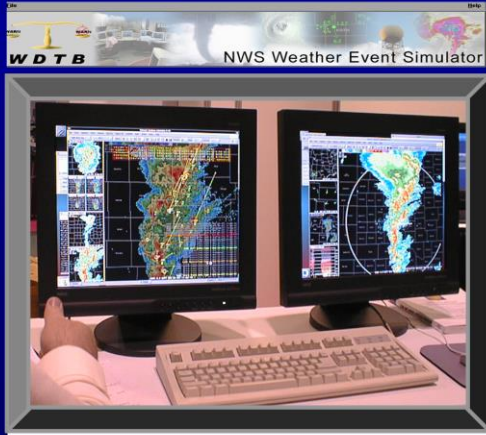
Knowledge of Conceptual Model



Develop procedures which help recognition in real time

The CTA found that expert warning forecasters are very familiar with mental and conceptual models. This begins taking shape during the expectation phase before echoes appear on the radar screen. It was important for these forecasters to not get locked in on any particular threat, but rather consider a range of threat possibilities, each with an associated likelihood. This helps focus effort on the biggest threats and ensure resources are arranged to support that effort. At the same time, it was necessary to prevent tunnel vision (“flash flooding is not a threat today”) which can contribute to the likelihood of low probability or rare events going undiagnosed. In addition, the experts were aware that oftentimes the signatures will not fit the “textbook” classics, but that they can still be good enough.

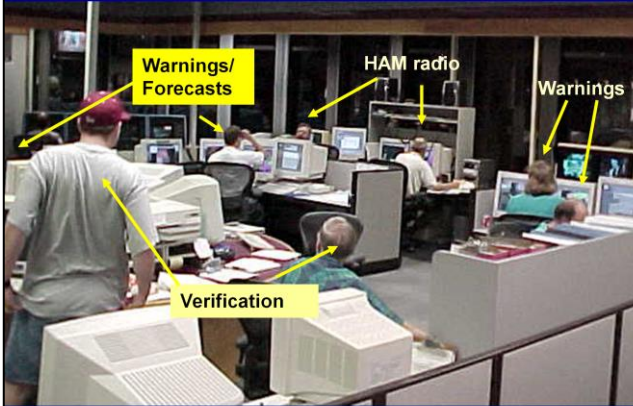
Finding: Experts Study Numerous Past Events



- Help to expand repertoire
- Learn something from all events, not just local
- Use simulations to develop critical thinking skills
 - Focus on reasoning for decisions
 - Focus on any or all elements of the warning process

The experts were very prone to looking at numerous events in hindsight. This included events from other areas, even other countries, and events which, even though they were not common to their particular locale, were in the realm of possibilities. The benefit of doing this was to expand exposure and possibilities, as well as develop critical thinking skills. They viewed simulations as a challenge and sought to get the most out of any event they experienced.

Finding: Experts Know the Importance of Working in Teams



- Ability to work in teams is critical
- Individuals as well as the team must maintain situation awareness
- Employ the use of warning coordinator to monitor:
 - Products/Information flow
 - Staff
 - Workload
 - Warning Sectors
 - Equipment
 - Coordination
 - Communication

The teamwork focus of the experts interviewed was a common theme. They considered success and failures as belonging to the office and the NWS, not just the person composing the warning. Each team member has a responsibility for communication and coordination as well as situation awareness. They valued the role of each member of the team, regardless of their experience level. The experts endorsed the use of a warning coordinator to help ensure nothing gets overlooked and that the message the office is sending is understood by each team member.

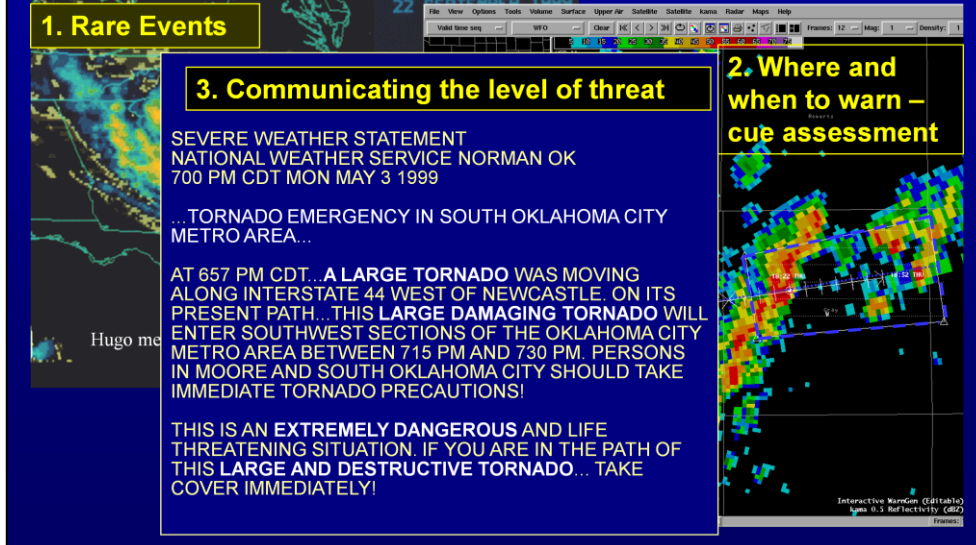
Finding: Experts are Focused on Serving the Public



- Sensitive to role in protecting public
- Attempt to keep tuned with public vulnerability
- Focus is on communicating level of threat
- There is effort to get the public to react correctly

The experts viewed issuing warnings as a social action which was based on a scientific decision. They were very focused on their relationship with the public and public vulnerabilities at any point in time. They did not view their job as just issuing a warning, but rather making attempts to elicit the best public response to ensure safety. A focus on a constant and consistent communication of the threat, both from sources within the office and with outside partners, was a critical piece of the job.

Finding: The Experts Biggest Challenges



The biggest and most important challenge that the forecasters interviewed found in their jobs was the ability to rise to the occasion when the “big event” presented itself. It was believed that this was where the NWS needed to meet and even exceed all expectations. They tended to look at all events as having that potential, knowing that it is often not known ahead of time which event will be the one that defines your reputation or that of your office or the agency. Their belief was that seeing and properly reacting to these catastrophic events as they are unfolding (correctly assessing the relevant cues) is the biggest challenge one is faced with in the forecast and warning environment. The importance of categorizing the threat once it is realized in words which convey not only its magnitude but its certainty was thought to be imperative.

Summary

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What is a cognitive task analysis (CTA)?

- A study of the mental processes needed to perform a task efficiently
- A procedure that identifies the most likely to fail in a complex task
- A procedure which maps behaviour during high stress situations
- A study focused on understanding high level task solutions

AWOC Core, IC3, Lesson 2 - CTA

Quiz - 2 questions

Last Modified: Apr 13, 2015 at 04:20 PM

PROPERTIES

On passing, 'Finish' button: [Goes to Next Slide](#)

On failing, 'Finish' button: [Goes to Next Slide](#)

Allow user to leave quiz: [After user has completed quiz](#)

User may view slides after quiz: [At any time](#)

Show in menu as: [Multiple items](#)



Edit in Quizmaker



Edit Properties

Questions?

1. Check with your AWOC facilitator (most often the SOO)
2. Send your questions to
awoccore_list@wdtb.noaa.gov

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